

Turbo Chain™ Goes Beyond Standard Ethernet Ring Redundancy

In recent years, redundant Ethernet technology has been rapidly and popularly adopted due to its enhanced reliability. However, building or expanding complex redundant network infrastructures for industrial applications can be taxing due to the lack of an accommodating technology. In addition, as redundant networks become more heavily utilized, networking requirements consequently grow more demanding, making some redundant technologies inefficient in certain situations.

This article will explore various challenges presented by existing redundant networking technologies and introduce a new and innovative redundant solution that increases the efficiency and availability of multiple redundant connections in complex mission-critical industrial networks.

- * The Challenges of Building Reliable and Readily Available Redundant Networks
- * Current Network Redundancy Technologies
- * Turbo Chain™: A New Recovery System that Goes Beyond Current Redundant Ethernet Rings
- * Benefits of Turbo Chain™
- * Actual Case Studies

The Challenges of Building Reliable and Readily Available Redundant Networks

Ease of deployment, high availability, rapid failure recovery, and future expandability are important features for industrial redundant Ethernet networks.

For industrial redundant Ethernet networks, one of the most common problems encountered today is the lack of a technology that simplifies building high-availability networks containing complex redundant connections. This requirement is sorely needed for industrial applications such as wind power, oil pipelines, and railway automation networks, which require large redundant Ethernet networks that may encompass multiple locations over substantial distances and require topologies that are more flexible.

Other problems such as troublesome network expansions or slow failure-recovery are also frequently encountered. As we go over the pros and cons of standard redundant technologies, we will discuss how Turbo Chain™ can address these issues precisely and efficiently.

Current Network Redundancy Technologies

Many existing mechanisms can enhance fault-tolerance in an Ethernet network. The most common of these are STP, RSTP, and proprietary ring redundancy.

Spanning Tree Protocol (STP)

STP automatically designates redundant links in an arbitrary mesh network, and then reactivates one or more of the links when active links fail. Although this type of redundancy can be used with networks with complicated topologies, the recovery time is too slow for industrial applications.

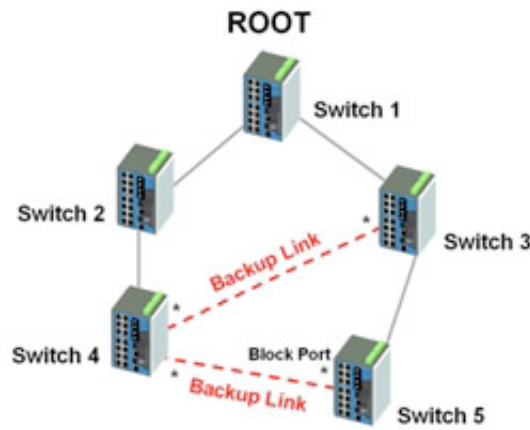


Figure 1: Spanning Tree Protocol blocks redundant ports to resolve loops

Rapid Spanning Tree Protocol (RSTP)

RTSP improves somewhat on STP's slow recovery time, but remains unsuitable for many mission-critical applications.

Proprietary Ring Redundancy

Ring redundancy is a cost-effective solution with excellent recovery times, but has limitations in topology flexibility and expandability.



Figure 2: Example of ring redundancy

Turbo Chain™: A New Recovery System that Goes Beyond Current Redundant Ethernet Rings

Moxa's Turbo Chain™ is an advanced redundancy technology that solves the slow recovery time of STP/RSTP, and the inflexible topology or restricted rings of proprietary ring redundancy.

Use Turbo Chain™ with any Moxa managed Ethernet switch to build a solid foundation for creating mission-critical and multiple redundant network connections with fast fault recovery time, flexible topology, unlimited network expansion, and cost-effective configuration—for today and tomorrow. Using the innovative "chain" concept, network administrators can create any type of redundant topology among any network segment. Configuring Turbo Chain™ is easy; simply connect several Ethernet switches together to form a daisy-chain, where a Head-Switch and a Tail-Switch (the edge

switches at the two sides of the chain) are configured first, then the remaining switches are configured as member switches. Next, link the two ends of the chain to an Ethernet network. That's it, setup is finished!

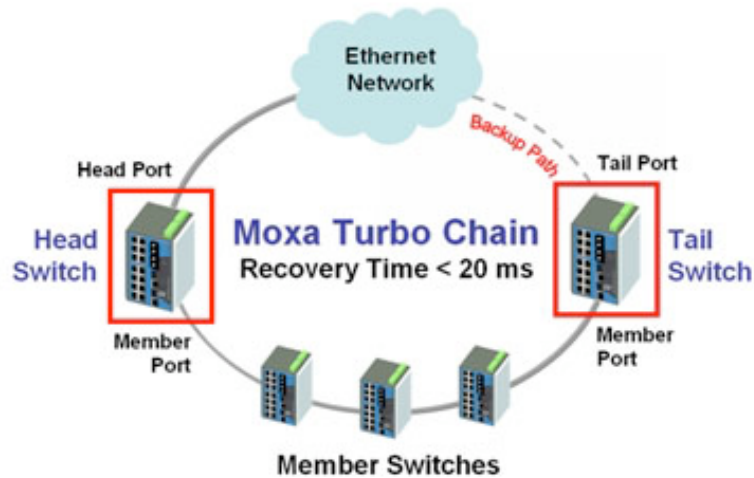


Figure 3: Turbo Chain™ Networking

Turbo Chain™ provides the prompt redundancy that is required for industrial applications. Once a chain-segment fails, the blocked path (link between the tail-switch and the outside network) will activate instantaneously with a **recovery time of under 20 milliseconds**. This fast recovery will ensure that the industrial Ethernet network remains available, with almost zero downtime.

Benefits of Turbo Chain™

Turbo Chain™ presents significant benefits and advantages for industrial networks, which often require complex redundant topologies, and it enables the highest reliability and availability for industrial Ethernet network applications. Whenever a network adopts a multiple ring architecture, Turbo Chain™ is the best solution for the following reasons: flexible and scalable construction, unrestricted expansion, fast fault recovery, and cost-effective deployment.

Build Highly Flexible and Scalable Redundant Topologies

Turbo Chain™ features extreme versatility for accommodating any type of complex network topology. With the chain methodology, network engineers now have the freedom to create as many redundant connections as they need by simply linking a new Turbo Chain™ to any segment of the Ethernet Network.

Unrestricted Expansion to Form Scalable Redundant Networks

Turbo Chain™ allows unlimited and easy network expansions. Network engineers do not need to reconfigure the existing network, but rather, use Turbo Chain™ to scale up the redundant networks directly. In addition, Turbo Chain™ can be connected to a network using other redundant technologies, such as STP, RSTP, and Moxa's Turbo Ring™.

Reliable and Immediate Fault Recovery Mechanism

Turbo Chain™ offers industrial-grade redundancy that is capable of tolerating network-segment failures. If any given network link fails, Turbo Chain™ will activate the blocked path and continue forwarding data—all with a super fast recovery time of less than 20 milliseconds.

Cost-effective Deployment

Turbo Chain™ reduces deployment time, effort, and installation costs since the connection of different redundant networks can be achieved without ring coupling cables.

When compared with ring-coupling technology, Turbo Chain™ presents significant cost reductions, since Ethernet ports and kilometers of fiber-cabling used for ring coupling paths are eliminated. This type of deployment is ideal for applications that require network redundancy and have budget considerations and cabling difficulties associated with coupling. Figures 5, 6, and 7 illustrate Turbo Chain's™ cost-effectiveness.

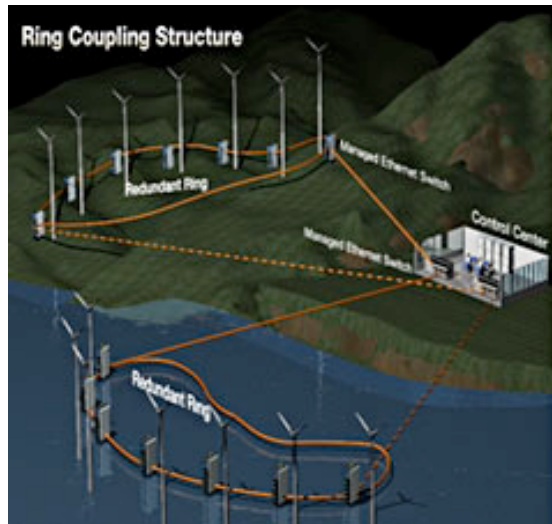


Figure 4: Ring coupling structure

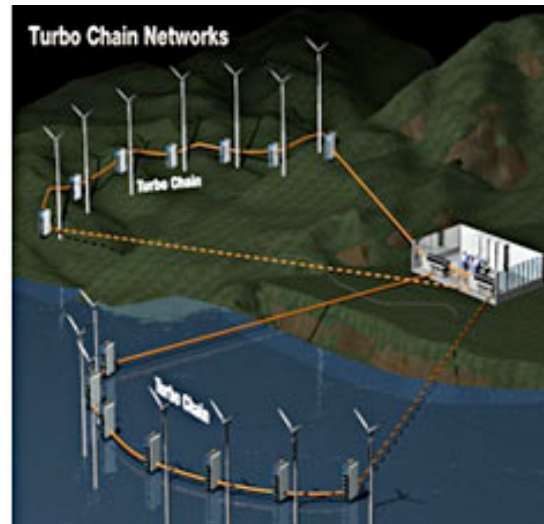


Figure 5: Turbo Chain™ network

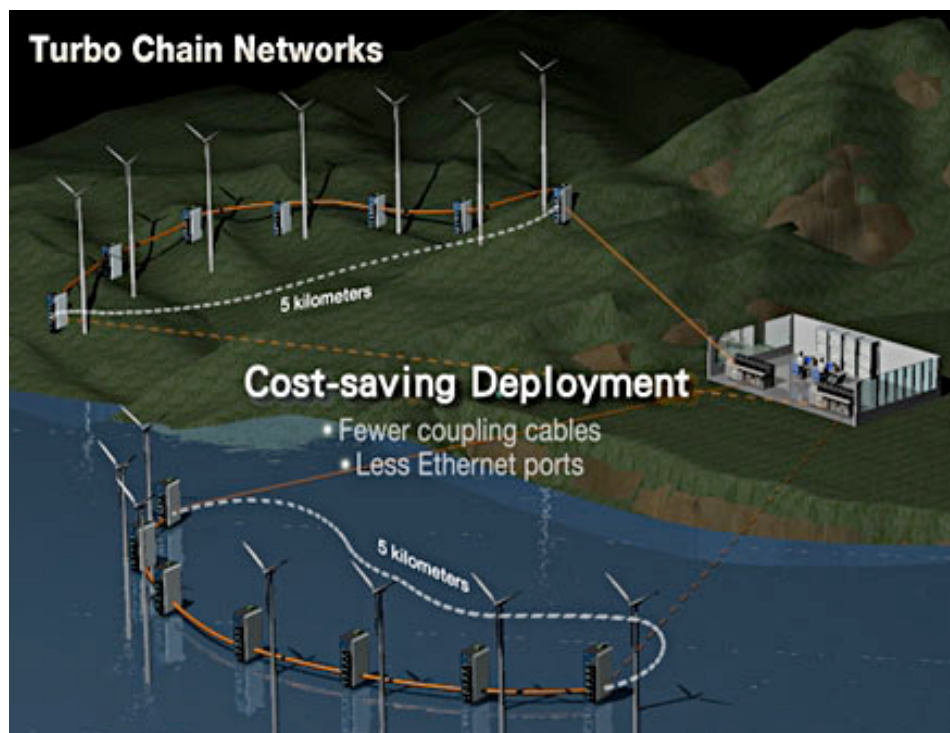


Figure 6: Turbo Chain™ cuts 10 km of coupling cables for this oil pipeline system (actual case study)

Turbo Chain™ allows for unlimited redundant network expansions without reconfiguration, and since Turbo Chain™ is compatible with standard IEEE 802.1w/D RSTP, STP, and Turbo Ring protocols, Turbo Chain™ can be integrated into other Ethernet networks.

Actual Case Studies

Wind Power System

Wind farms consist of windmills scattered over a wide area, and redundant Ethernet network connections are an ideal solution to connect devices at each windmill to the same network. However, typical ring technologies are awkward, costly, and make it inconvenient when linking the nodes together. Turbo Chain™ is the best solution, because it satisfies all the requirements of this application: a reliable self-healing network (recovery time < 20 ms), cost-saving deployment, and high scalability and expandability so that more windmills can be conveniently added in the future.

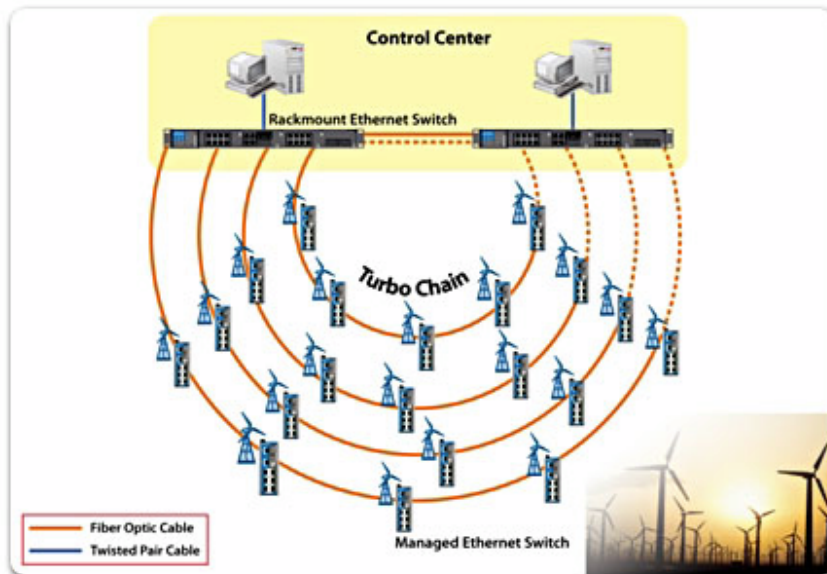


Figure 7: A Wind Power System Uses Moxa's Turbo Chain™ to Build a Network That Is Ready for Tomorrow

Railway System

Railway systems use a centralized redundant monitoring system to connect different sub-communication stations for real-time operation to ensure safe transportation. Moxa's Turbo Chain™ allows the railway system to quickly and easily scale up whenever the network needs to be expanded. Instead of creating another sub-ring for the new network, or rerouting/reconfiguring the existing network, administrators can simply chain-up the new nodes, and hook up the chain to the current network. Regardless of whether or not the existing network is running STP, RSTP, or Turbo Ring protocols, Turbo Chain™ can interoperate reliably with any of them.

Summary

Industrial applications require reliable, redundant network systems to ensure non-stop network operations. Since the complexity of industrial field wiring continues to increase, deploying redundant connections with flexibility and scalability has become imperative.

Moxa's Turbo Chain™ redundant technology, which is supported by all of Moxa's industrial managed Ethernet switches, is the solution with the highest availability, and it allows network administrators to easily build multiple redundant connections that are highly adaptable. The benefits of Turbo Chain™ redundant technology include:

- * Flexible and expandable network construction, with zero network reconfiguration effort.
- * Interoperability with various redundant networks, such as STP, RSTP, and Moxa's Turbo Ring™ networks.
- * Rapid fault recovery (recovery time < 20 ms) for reliable system operations.
- * Cost-effective deployment compared with ring coupling.